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Agricultural Experiment Station
College of Agriculture, West Virginia University
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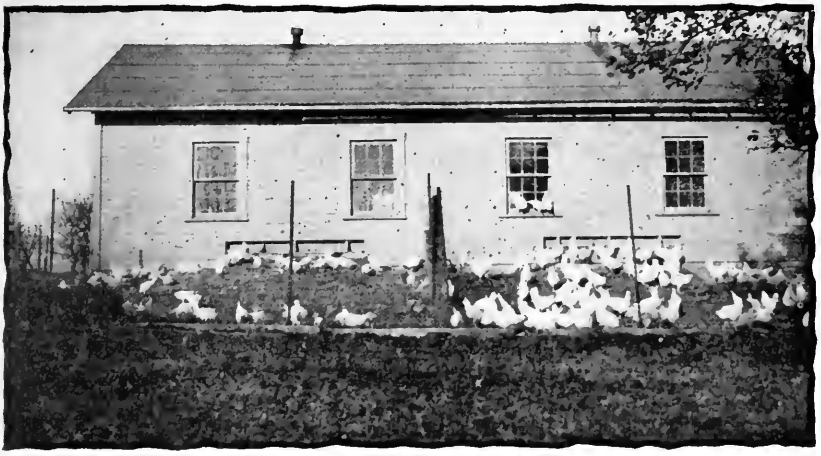
INFLUENCE OF RATIONS FED TO GROWING CHICKENS ON THE CHARACTERISTICS OF THE ADULT FEMALES

(TECHNICAL)



Brooder House in Which Chicks Were Raised. On the Left is Shown the Poorly-Fed Lot and On the Right the Well-Fed Lot.

BY

HORACE ATWOOD

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THE INFLUENCE OF RATIONS FED TO GROWING CHICKENS ON THE CHARACTERISTICS OF THE ADULT FEMALES

When chickens are raised by artificial means, the conditions surrounding their early growth and development are frequently far from ideal. During the period of incubation the temperature may become too high or too low, or possibly not enough fresh air may be supplied during the latter part of the hatch at which time the need is greatest. After the chicks are placed in the brooder, their anatomically poorly-protected lungs may not be kept warm enough at night and many of the chicks may be injured or may die through inflammation of the lungs. The feed which they receive during the growing period may be too scanty in amount or its composition may be unsuited to their requirements.

To what extent, if at all, do any or all of these or other related factors affect the future productivity of the females? This question opens a vast field for experimental inquiry, for if it should be shown that a certain method of handling the growing stock affects favorably or unfavorably the fecundity of the females or the vigor of their progeny, then it would be necessary through repeated trials to determine the best method for handling the growing chickens so that their future fecundity would be at a maximum and their offspring most vigorous.

The influence of early environment, including the food supply, upon the later fecundity of the females and the vigor of their offspring, is a fundamental problem of the poultry industry because it is possible that improved breeding and better methods of feeding and handling the mature stock may not bring about the greatest possible benefits unless accompanied by proper methods of raising the chicks.

The solution of the problem of the influence of rations is complicated by the forces of heredity which may cause one female to

be an extra good layer and another to be a poor layer. In this experiment the production of sisters only is compared.

The work described in this publication has been carried on for the purpose of determining whether the ration fed to growing chicks influences (1) either the number or the weight of the eggs laid by the females after they have arrived at sexual maturity, (2) the effect of the ration on the mature live weight of the females, or (3) the effect upon the age of arriving at sexual maturity.

General Plan of Experiment

The general plan of the experiment was as follows. Pedigreed chickens hatched in the same incubator were divided into two lots similar in respect to parentage. Both lots were fed the same basic grain ration. In addition to this ration, one lot received a liberal supply of skim milk, while the other lot was fed but little milk. The cockerels were removed at broiler age, and somewhat later all pullets were removed except where there were sisters in each lot. As soon as the first egg was laid the two lots of sisters which had been fed the two contrasted rations were placed together in one flock, and a trap-nest record was kept of their egg production and the weight of the eggs laid. When the chickens were small, each lot was weighed weekly. Later, after the pullets began to lay, each pullet was weighed monthly.

The experiment was started July 24, 1920, and in this publication data are presented covering the two laying seasons of 1921 and 1922. In 1921, chicks were hatched from eggs laid by the fowls then in the experiment and data covering these birds are presented for the laying season of 1922.

Hatching the Eggs

Table 1 gives the band numbers of the sires and the dams and certain details of the hatch from which the chicks used in the first experiment were obtained.

TABLE I.—Record of Hatch of Chicks Used to Start the Experiment

Sire's Number	Dam's Number	Number of Eggs Incubated	Number of Eggs Infertile	Number of Chicks Hatched
192	**94**	**8**		**8**
192	101	6	1	4
192	104	8		4
192	107	8		8
192	109	6		5
193	**12**	**9**		**9**
193	14	9	2	5
193	15	5		3
193	18	8	1	4
193	22	8		7
194	**7**	**8**		**2**
194	10	10		10
194	30	7		7
194	34	8		6
194	35	7	4	2
194	37	8	5	3
194	39	7	1	5
194	45	8		6
194	46	9	1	8
194	47	9	6	3
194	Y9731	7	3	4
195	**49**	**7**		**6**
195	55	7		7
195	65	9	2	6
195	66	7		7
195	73	5		2
195	Y9779	6		5
196	**2**	**6**	**4**	**2**
196	19	8		8
197	**82**	**6**		**5**
197	84	10		6
197	88	8		3
197	91	8		5
197	Y9791	6		4
198	**134**	**9**	**3**	**4**
198	137	9		9
198	138	8	1	5
198	Y9873	7		7
199	**103**	**8**		**7**
199	123	8	2	0
199	126	7		5
199	130	9		2
199	135	5		5
199	Y9729	5		2
200	**3**	**6**		**6**
200	16	10		8
200	28	7		7

Cyphers incubator was used and was started July 24, 1920.

When the chickens were removed from the cheese-cloth sacks in which the eggs from each hen had been placed just before they began to pip, they were leg banded and alternately placed in two lots

designated as Lot A and Lot B. Two similar Newtown brooders located in adjoining rooms in the same building were used for brooding the chickens, and the out-door runs were reduced to 400 square feet for each flock so as to eliminate the possibility of the chickens' obtaining a sufficient quantity of insects and worms to influence the results.

Feeding the Chicks

During the first week both lots of chickens were fed a similar ration, and the feeding experiment began when they were one week old.

Tables II and III which follow show the amount of feed consumed each week, the number of pounds of grain consumed per week per hundred chicks, and the weight of the chickens each week calculated per one hundred chickens.

TABLE II.—Amount of Feed Consumed Each Week Until Pullets Began to Lay

Week of Test	Scratch Feed Lbs.		Corn Meal Lbs.		Wheat Bran Lbs.		Wheat Middlings Lbs.		Corn Lbs.		Wheat Lbs.		Oats Lbs.		Condensed Buttermilk Lbs.		Meat Scrap Lbs.		Skim Milk Pints	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1st*																				
2nd	2.9	3.0	9.7	8.7	1.0	0.9	1.0	0.9							5.4				5.0	
3rd	2.5	2.5	11.7	8.8	1.3	0.5													18.5	3.5
4th	2.0	1.5	20.0	15.4	1.5	0.5													33.0	2.5
5th	5.0	3.5	13.4	8.1	8.0	5.3													39.0	7.5
6th	8.0	5.0	13.6	9.0	6.8	5.0													28.0	4.5
7th	11.5	6.0	20.0	9.6	10.0	4.8													39.0	3.0
8th	9.5	6.2	28.8	10.2	14.4	5.1											3.5		54.0	5.0
9th	10.7	6.2	17.0	6.0	17.0	6.0	17.0	6.0									1.7		52.0	2.0
10th	22.7	10.2	16.0	6.6	16.0	6.6	16.0	6.6									2.7		82.0	10.0
11th	22.2	13.5	19.0	7.5	19.0	7.5	19.0	7.5									3.5		18.0	7.0
12th	22.7	12.7	23.5	8.1	23.5	8.1	23.5	8.1									3.2		54.0	6.0
13th	27.0	11.0	29.6	10.0	29.6	10.0	29.6	10.0									4.7		78.0	4.0
14th	36.5	11.0	29.0	13.0	29.0	13.0	29.0	13.0									2.7	1.7	99.0	24.0
15th	49.7	10.7	24.7	16.0	24.7	16.0	24.7	16.0									2.7	2.2	36.0	21.0
16th	49.7	17.0	27.8	21.3	27.8	21.3	27.8	21.3									2.5	3.2	35.0	51.0
17th	7.7	10.0	6.5	6.0	6.5	6.0	6.5	6.0			29.2	13.7					6.0	2.0	30.0	25.0
18th			5.0	5.1	5.0	5.1	5.0	5.1	34.0	15.0	9.0	5.0					3.2	2.0	28.0	
19th			2.5	4.2	2.5	4.2	2.5	4.2	36.0	18.0	10.0	10.0							28.0	
20th			6.1	4.2	6.1	4.2	6.1	4.2	38.5	14.5					12.0				4.0	
21st			6.4	2.7	6.4	2.7	6.4	2.7	13.5	13.5					8.0	1.0				
22nd			1.7	3.9	1.7	3.9	1.7	3.9	20.9	12.5			9.0	6.0	4.5	1.0				
23rd			1.6	2.6	1.6	2.6	1.6	2.6	23.1	21.0										

*The lots were fed a similar ration.

TABLE III.—Number and Weight of Chickens and Number of Pounds of Grain and Meat Scrap Consumed Weekly Per Hundred Chickens

Week of Test	Number of Chicks at Beginning of Week		Weight of Chicks Per 100 at Beginning of Week		Pounds of Grain and Meat Scrap Per 100 Chicks Per Week	
	A	B	A	B	A	B
1st						
2nd	126	119	10.8	10.2	11.6	11.3
3rd	120	115	14.1	11.2	12.9	10.3
4th	120	113	18.1	12.3	19.6	15.4
5th	118	105	24.9	14.0	22.4	16.1
6th	116	101	32.6	17.9	24.5	18.8
7th	112	95	42.7	21.1	37.0	21.5
8th	110	93	55.4	24.5	51.1	23.1
9th	110	92	69.4	29.0	57.6	26.3
10th	110	90	84.4	33.2	66.7	33.3
11th	110	90	108.8	39.3	75.2	40.0
12th	110	89	126.0	44.4	87.6	41.6
13th	110	88	151.4	52.6	109.5	46.6
14th	108	87	174.4	60.8	116.8	59.4
15th	108	86	201.4	85.6	117.1	70.8
16th	108	85	213.4	107.1	125.5	98.9
17th	58*	45	215.8	119.5	107.6	97.1
18th	58	45	221.4	132.4	105.5	82.9
19th	58	45	237.6	144.6	92.2	90.2
20th	58	45	241.0	156.5	98.0	60.2
21st	30**	29	257.7	174.5	109.0	74.5
22nd	30	29	242.0	173.1	116.7	104.1
23rd	30	29	266.6	187.3	93.0	99.3

*Cockerels removed.
**Females removed except sisters in each lot.

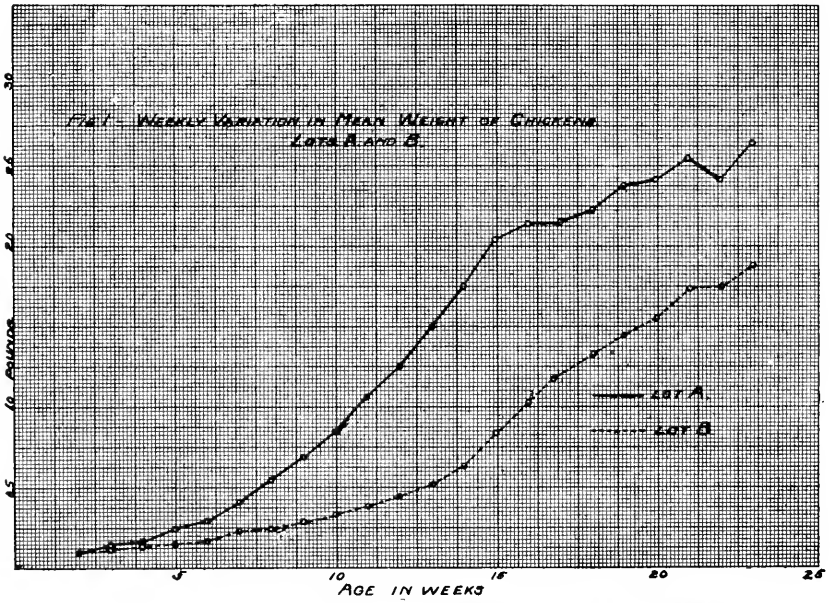


Fig. 1.—Weekly Variation in Mean Weight of Chickens.

Greater Grain Consumption in Lot A.—Both lots of chickens were fed liberally in respect to their grain ration, yet Lot A which received the liberal supply of milk consumed more grain than did Lot B. Table III shows that on the seventh week and extending to the fifteenth week Lot A consumed practically twice as much grain per bird per week as was the case with Lot B. At that time on account of the cold weather it seemed necessary to feed Lot B more milk and meat scrap than formerly, so during the last seven or eight weeks the difference in the amount of grain consumed was less marked. Both lots were provided with cabbage or sprouted oats as succulence.

Rate of Gain in Weight.—Table III and Fig. 1 show that Lot A grew so much faster than Lot B that on the seventh week the chickens fed the milk ration averaged twice as heavy as those receiving no milk. On the thirteenth week they were almost three times as heavy, and although the difference later was not so marked, yet it continued to the end.

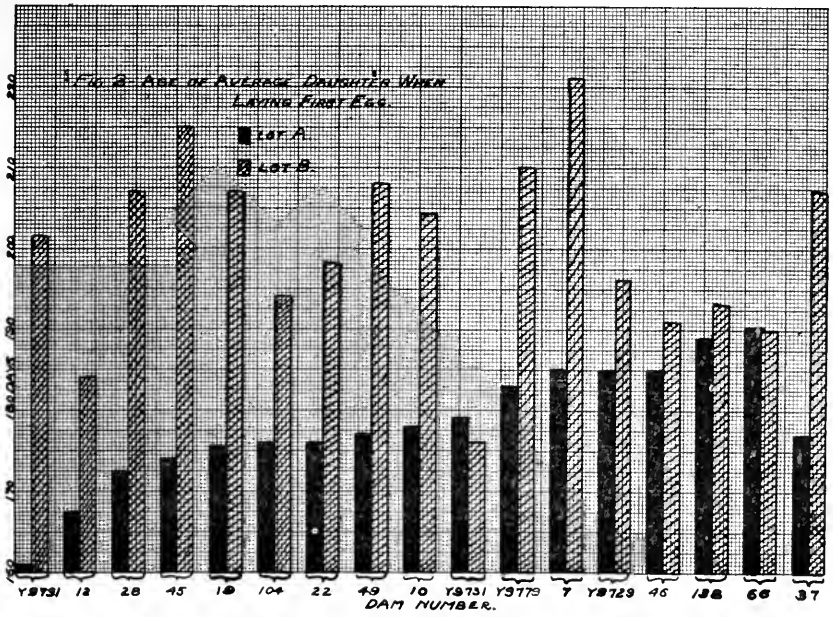


Fig. 2.—Age of Average Daughter When Laying First Egg.

Mortality of the Chicks.—From the beginning of the second to the beginning of the seventeenth week, when the cockerels were removed, 18 chickens died out of Lot A and 34 out of Lot B. Most of the deaths were caused by inflammation of the lungs due to the difficulty of properly brooding chickens with a mammoth brooder

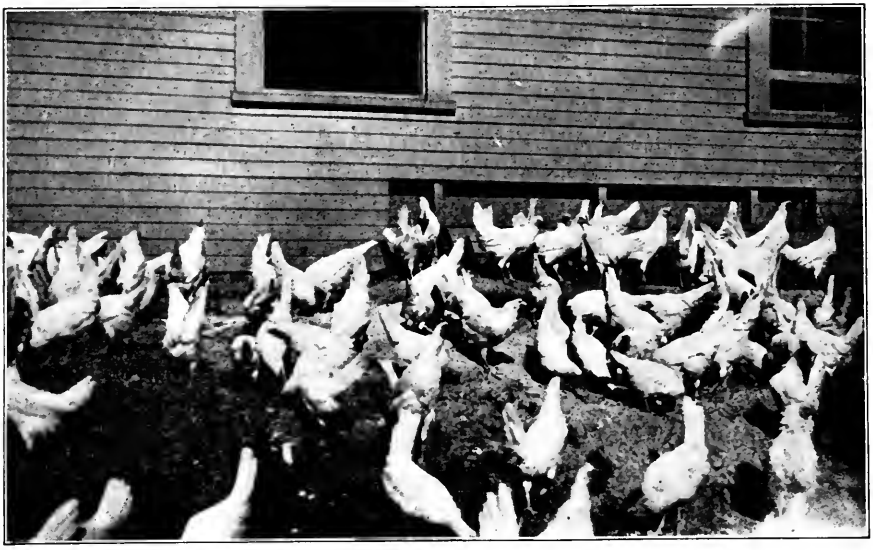
in hot weather. At the start the brooders were operated at the same temperature, but on the approach of cold weather the chickens in Lot B, being smaller and not so well feathered, seemed to require and were given more heat than those in Lot A.

Age When First Egg Was Laid.—The first egg laid by any of the pullets was laid January 21, 1921, and the birds were transferred to their permanent laying quarters on the following day. Thereafter both lots of pullets ran together in one flock under practically free-range conditions.

Table IV shows the band numbers of the dams and the band numbers of their daughters in each lot, together with the age in days of each daughter when the first egg was laid.

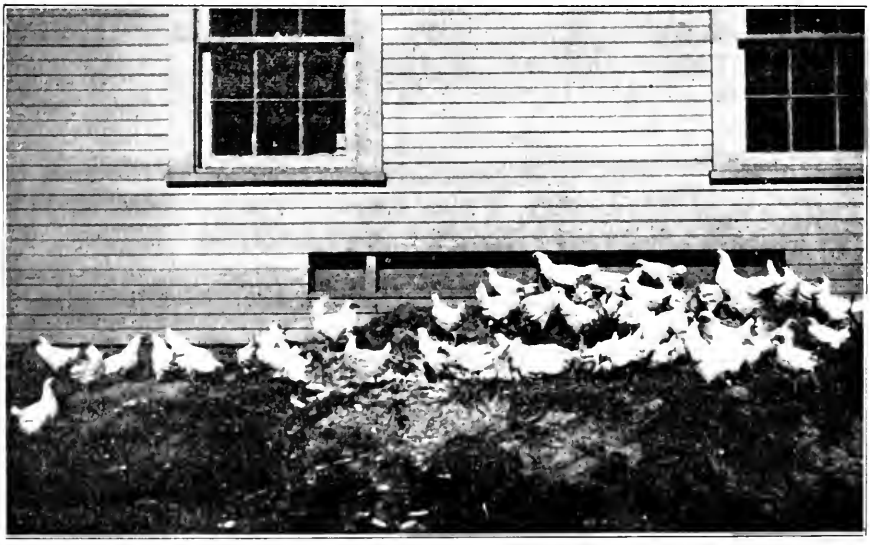
TABLE IV.—Age in Days When First Egg Was Laid

Number of Dam	LOT A		LOT B	
	Number of Daughter	Age First Egg	Number of Daughter	Age First Egg
Y9729	311	185	314	196
Y9779	317	183	310	218
			344	202
66	308	200	338	190
	313	182		
	322	189		
104	330	176	303	194
138	327	190	341	199
	351	188	337	183
			339	198
Y9731	356	179	304	176
Y9791	349	161	346	210
			321	193
45	333	174	312	219
			350	211
46	328	193	343	191
	307	177		
12	301	175	305	180
	309	160	316	178
			323	184
			306	194
22	325	176	319	198
49	324	178	329	208
	320	171		
	342	182		
10	332	172	353	219
	355	184	352	196
			335	198
28	336	169	354	207
	331	176		
7	302	185	348	221
19	326	168	334	217
	315	183	345	197
37	347	177	340	207



LOT A

Well-Fed Fowls 107 Days Old



LOT B

Poorly-Fed Fowls 107 Days Old

TABLE V.—Age of Pullets in Days When First Egg Was Laid Relative to Weight of Pullets January 22, 1921

Weight of Pullets in Pounds, January 22, 1921	Age in Days													
	160	165	170	175	180	185	190	195	200	205	210	215	220	
1.4											1	1		2
1.5													2	2
1.6													1	1
1.7										1				1
1.8						1								1
1.9										1	1		1	3
2.0								1	1					2
2.1				1			1		3					5
2.2				1					1		1			3
2.3								1						1
2.4						2		1						3
2.5					1		1	2						4
2.6					1		1	1						3
2.7								1	1					2
2.8					1									1
2.9			2	1	2	2	1							8
3.0			2	3	1	1								7
3.1	1						1							2
3.2														
3.3				1										1
3.4						1								1
3.5														
3.6					1									1
3.7				1										1
	1		4	8	7	7	5	7	6	2	3	1	4	55

Coefficient of Correlation — .72 ± .05.

The pullets in Lot A were 179±1.9 days old when they began to lay, while in Lot B they were 199.4±3.8 days old, a difference in favor of the well-fed lot of 20.4±4.2 days in earliness of production.

Figure 2 shows graphically the age of the average daughters in the two lots when first egg was laid.

Table V shows the relationship between the weight of the pullets on January 22 and the age in days when the first egg was laid. In this table the age of the pullets in days at the time of laying their first egg is relative and the weight of the pullets on January 22 is subjective. For example, of the two fowls each weighing 1.4 pounds on January 22, one was 210 days old and the other was 215 days old when the first egg was laid.

The average, or mean, age of the pullets when laying the first egg was 189.9 days and their mean weight January 22 was 2.5 pounds.

The coefficient of correlation of $-.72 \pm .05$ indicates that the heavier fowls of the flock were younger when laying the first egg than the lighter pullets. (The coefficient of correlation may vary from 1 through 0 to —1. A zero correlation would indicate that there was no relation between the weight of fowl and age when laying first egg. A positive correlation coefficient would indicate that the heavier fowls were older than those lighter in weight when they began to lay.

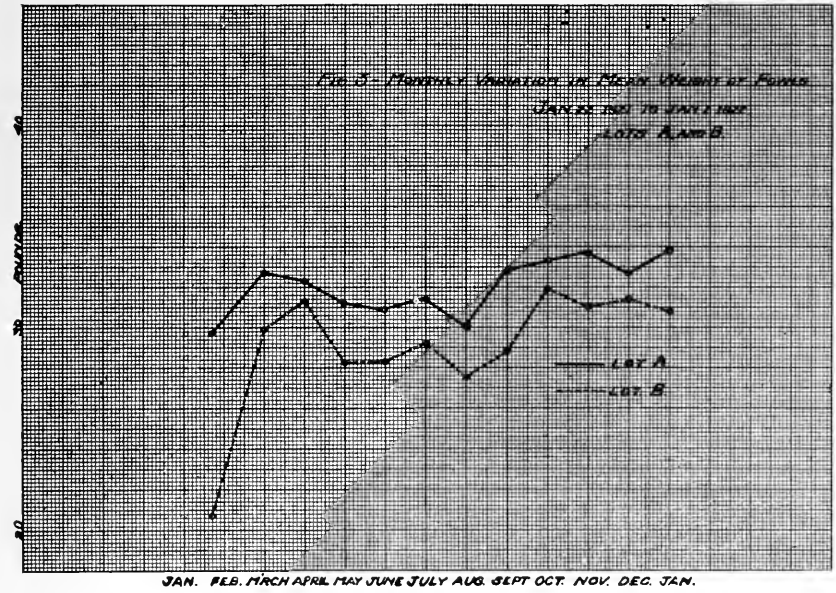


Fig. 3.—Monthly Variation in Mean Weight of Fowls.

WEIGHT OF PULLETS

All the pullets were weighed on January 22 when they were transferred to their laying quarters, and beginning on March 1 they were weighed regularly at the beginning of each calendar month. In all cases this weighing was done at night soon after the pullets had gone to roost.

Table VI shows the weights of the pullets in Lot A, and Table VII the weights in Lot B. Fig. 3 shows the fluctuations in the average weights of the daughters.

Tables VI and VII and Figure 3 show that not only were the

pullets in Lot B smaller on January 22, when they were placed in the laying house with Lot A, but that they also permanently remained smaller. Due to the better balanced ration fed Lot B, beginning January 22, the pullets of this lot made a gain in live weight of almost one pound each by March 1, while the pullets of Lot A increased in weight only about one-third as much. The average weight of the average well-fed daughter for September, October, November, and December, 1921, was $3.30 \pm .03$ pounds, while those that had been poorly fed averaged $3.05 \pm .04$ pounds, or a difference of about 8 percent. Figure 7 shows that the difference in weight persisted during 1922 and it is evident that fowls that have been stunted by receiving a poor ration while young will never attain their normal weight even though fed a normal ration later.

TABLE VI.—Weight in Pounds of Pullets in Lot A, 1921

No. of Dam	No. of Daughter	January	March	April	May	June	July	August	September	October	November	December
Y9729	311	3.4	3.3	3.7	3.7	3.6	3.7	3.6	3.7	3.6	3.1	3.1
Y9779	317	3.0	3.8									
66	308	2.7	3.6	3.1	3.1	3.2	2.9	2.9	3.3	3.7	3.7	3.7
	313	2.9	3.4	3.4	3.7	3.6	3.6	2.8	3.2	3.9	3.9	4.0
	322	2.9	3.3	3.4	3.5	3.4	3.4	3.4	3.6	2.9	3.4	3.7
104	330	2.9	3.3	3.2	3.0	2.6	2.9	2.6	3.2	3.2	3.1	3.3
138	327	2.6	3.3	2.9	2.8	2.8	2.9	2.4	3.0	3.3	3.5	3.3
	351	3.1	3.3	3.2	3.1	3.2	3.2	3.3	3.0	3.1	3.7	4.1
Y9731	356	2.9	3.2	3.2	2.8	2.9	2.9	2.3	2.9	3.3	3.4	2.9
Y9791	349	3.1	3.1	3.2	2.9	3.0	3.1	2.7	3.2	3.3	3.7	3.2
45	333	3.3	3.2	3.4	3.4	3.2	3.1	3.0	3.4	3.5	3.1	3.3
12	301	3.0	2.9	3.0	2.8	2.8	2.8	2.8	2.8	3.3	3.4	3.6
	309	3.7	3.8	3.7	3.6	3.6	3.4	3.5	3.8	3.7	4.1	2.9
22	325	3.0	3.4	3.4	3.0	3.1	3.2	3.4	3.4	2.7	2.8	3.0
49	324	3.0	3.3	3.4	3.3	3.4	3.4	3.3	3.5	3.1	3.3	3.8
	320	2.9	3.4	3.2	2.8	2.5	3.2	3.1	3.2	3.0	3.0	3.1
	342	3.6	3.7	3.8	3.5	3.5	3.3	3.7	3.8	3.9	3.2	3.7
10	332	2.9	3.4	3.4	3.4	3.0	3.2	3.0	3.3	3.6	3.8	3.6
	355	2.4	3.0	2.8	3.0	2.7	2.8	2.9	3.0	3.1	3.2	2.6
28	336	3.0	3.0	3.1	2.7	2.6	2.8	2.6	2.6	2.9	3.3	3.4
	331	2.1	3.5	3.5	3.1	3.3	3.2	3.3	3.7	3.1	2.9	3.2
7	302	2.9	2.2	2.4	3.2	3.2	3.1	3.2	3.4	3.5	3.9	3.2
19	326	3.0	3.4	3.3	3.2	3.2	3.1	3.2	2.6	2.8	3.1	3.5
	315	2.9	3.4	3.3	3.3	3.0	3.0	2.7	3.4	3.8	4.0	3.2
37	347	3.0	3.0	3.0	3.1	3.0	3.0	2.7	3.2	3.2	2.7	2.7
46	328	2.5	3.4	2.6								
	307	2.8	3.4	3.3								
Average Weight		**2.97**	**3.27**	**3.23**	**3.12**	**3.09**	**3.14**	**3.00**	**3.28**	**3.33**	**3.36**	**3.27**

TABLE VII.—Weight in Pounds of Pullets in Lot B, 1921

No. of Dam	No. of Daughter	January 22	March 1	April 1	May 1	June 1	July 1	August 1	September 1	October 1	November 1	December 1
Y9729	314	2.4	3.2	3.4	3.4	3.4	3.4	3.6	3.4	3.4	2.9	3.0
Y9779	310	1.9	2.5									
	344	2.0	3.0									
66	338	2.1	2.7	2.9	2.7	2.7	2.8	2.2	2.6	3.1	3.3	3.3
104	303	2.7	3.7	3.7	3.0	3.0	3.1	2.6	2.5	2.7	3.0	3.8
138	341	2.1	3.4	3.2	3.1	3.0	2.5	2.6	3.3	3.5	2.8	2.7
	337	2.4	3.1	3.3	2.6	2.8	2.7	2.6	2.7	3.1	3.7	3.3
	339	2.1	3.1	3.1	2.9	2.7	2.9	2.3	3.2	3.4	2.9	3.1
Y9731	304	2.2	2.9	2.9	2.6	2.7	2.9	2.5	2.4	2.6	3.0	3.1
Y9791	346	1.9	2.8	3.2	2.7	2.9	2.9	2.5	2.6	3.1	3.4	3.6
	321	2.3	3.1	2.9	2.7	2.7	2.5	2.2	2.5	3.1	3.4	3.3
45	312	1.5	2.5	3.1	2.8	2.6	2.9	2.5	2.5	3.4	3.2	3.3
	350	1.4	2.4	2.3	2.2	2.2	2.0	2.2	2.5	2.7	3.1	3.0
12	305	2.5	3.3	3.1	3.0	3.1	3.1	3.1	3.3	3.3	2.8	2.5
	316	2.6	3.2	3.3	3.5	2.8	3.0	2.6	3.2	3.5	3.7	3.0
	323	1.8	2.9	2.9	2.6	2.8	2.8	2.4	3.0	3.3	3.3	3.2
	306	2.6	3.9	3.6	3.6	3.7	4.0	4.2	3.9	4.4	4.6	3.1
22	319	2.1	3.0	3.0	2.5	2.2	2.5	2.3	2.7	3.2	3.3	3.0
49	329	2.2	3.1	3.2	3.2	3.2	3.1	2.7	3.0	3.1	3.2	3.3
10	353	1.6	2.1	2.6	2.5	2.5						
	352	2.0	3.1	3.1	3.2	3.0	3.1	2.6	2.9	3.4	3.3	2.7
	335	2.2	3.4	3.1	2.6	2.6	2.9	2.7	2.9	2.4	2.5	2.9
28	354	1.7	2.7	2.9	2.4	2.5	2.6	2.9	2.8	3.1	2.5	2.5
7	348	1.5	2.4	3.1	2.7	2.9	3.1	2.6	2.8	3.0	3.3	3.5
19	334	1.4	2.4	3.0	3.0	2.4	2.8	2.9	3.0	2.8	3.0	3.2
	345	2.5	3.8	3.6	3.5	3.4	3.3	3.5	3.5	3.8	3.1	3.4
437	340	1.9	2.8	3.0	2.5	2.8	2.9	3.4	3.1	2.7	2.5	2.5
46	343	2.4	3.3	3.2								
Average Weight		**2.07**	**2.99**	**3.13**	**2.82**	**2.83**	**2.92**	**2.75**	**2.88**	**3.19**	**3.10**	**3.14**

MANAGEMENT OF PULLETS

After the pullets were placed in their laying quarters, they had free access to dry mash in a hopper, and once a day a mixture of corn and oats was scattered in the litter covering the floor of the poultry house. The dry mash was composed of corn meal, 2 parts, and 1 part each of wheat bran, wheat middlings, and meat scrap.

At the start, in order that they might not nest outside and the eggs be unrecorded, the pullets were confined to the house until after practically all eggs for the day had been laid. Later in the season, after they had become fully accustomed to the trap nests, they were allowed free range on a bluegrass sod.

In spite of the utmost care in trapping, 2.4 percent of the eggs were laid outside the trap nests and in the following tables showing egg production and egg weights, these eggs have been disregarded.

Number and Weight of Eggs Laid

The eggs were weighed regularly early in the morning following the day on which they were laid.

As shown by Table IV and subsequent tables, the dams, in several cases, had unequal numbers of daughters in the two lots. The daughters of certain dams may be better layers or may lay larger eggs than the daughters of certain other dams, and if the mean egg production or the mean weight of the eggs laid by all the daughters in each lot were considered, this factor might obscure the effect of the two rations. To overcome this difficulty whenever a dam had more than one daughter in either lot the mean production of all of her daughters in that particular lot was taken in calculating the results. For example, in Table X the three daughters of Dam 66 gave a mean egg production of 129 eggs weighing 6,588.17 grams. The expression "average daughter" is used in this connection.

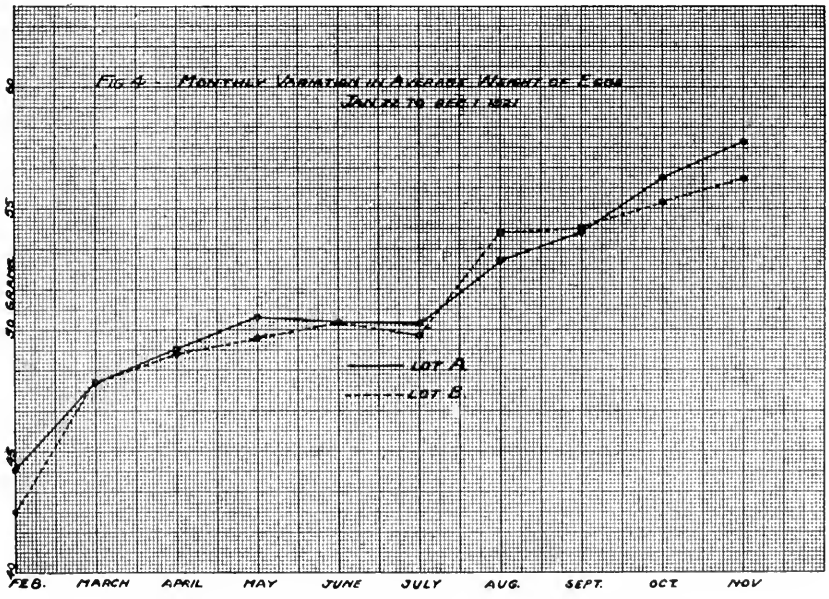


Fig. 4.—Monthly Variation in Average Weight of Eggs.

Table VIII shows the mean number of eggs and mean weight of eggs in grams laid by the "average daughter" per month until December, 1921. These data are shown graphically in Figures 4 and 5.

Particular attention has been given to the weight of the eggs laid by the two lots of pullets, for should it appear that the pullets poorly fed while young lay smaller eggs than those laid by the other lot, then it might be logical to conclude that the unfavorable early environment tends to reduce the vigor of the progeny.

See Memoir 31, Cornell Experiment Station, Ithaca, N. Y.

TABLE VIII.—Mean Egg Production and Egg Weight, Lots A and B, January 22, 1921, to December 1, 1921

Date	LOT A		LOT B	
	Average No. Eggs Per Daughter	Average Egg Weight Per Daughter	Average No. Eggs Per Daughter	Average Egg Weight Per Daughter
Jan.-Feb.	13.15	44.57	3.02	42.55
March	22.94	47.93	17.04	47.89
April	20.31	49.19	20.49	49.11
May	21.50	50.48	19.16	49.69
June	18.93	50.47	17.18	50.47
July	16.04	50.28	13.93	49.79
August	10.71	52.72	5.53	53.96
September	12.53	54.07	9.40	54.12
October	7.83	56.27	5.35	55.25
November	4.79	57.69	3.09	56.08

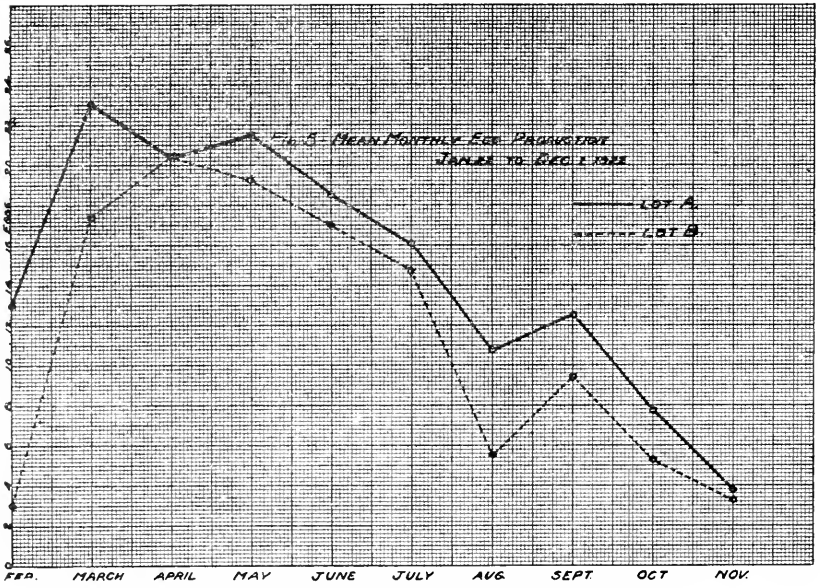


Fig. 5.—Mean Monthly Egg Production.

The weight of the eggs increased with a fair degree of regularity during the period covered by the table.

Weight of Fowls and Number of Eggs Laid.—What then is the relationship between the weight of the fowls and the number of eggs laid? In Table IX the average of the seven weighings of each fowl, March to September, was considered the average weight, and the number of eggs covered the total recorded production of each individual until September 1. The table is arranged without reference to the previous treatment of the pullets and no effort is made to balance the production or weight of one set of sisters against the other as in former tables. The table shows that the heavier fowls laid more eggs than did those lighter in weight.

TABLE IX.—Correlation of Egg Production (Number of Eggs Laid to September 1) Relative to Average Weight of Fowl

Average Weight of Fowls March to September (Lbs.)	Number of Eggs Laid																					
	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	
2.3	1																					1
2.4																						
2.5																						
2.6											1	1										2
2.7					1			1			1											3
2.8					1	1						1	1	2								6
2.9	1			1					1	2	1		1			1						8
3.0						2			1		1	1			1				1			7
3.1									1	1			1									3
3.2	1											1		1		1			1			5
3.3														1	1						1	3
3.4																2			1	2		5
3.5								1														1
3.6																	1				1	2
3.7																						
3.8																			1			1
3.9																		1				1
	3			1	2	3		2	3	3	4	4	3	4	2	4	1	1	4	2	2	48

Coefficient of Correlation $= + .63 \pm .06$.

Tables X and XI summarize the egg production and egg weight to December 1, 1921, at which time most of the fowls were moulting and had ceased to lay. Figure 6 shows the data graphically.

TABLE X.—Summary of Egg Production and Egg Weight to December 1, 1921. Lot A.

No. of Dam	No. of Daughter	Number Eggs Laid	Total Wt. of Eggs (Grams)	Average No. of Eggs	Average Total Wt. of Eggs (Grams)	Average Egg Weight Per Daughter
Y9729	311	180	9121.11	180	9121.11	50.67
66	308	56	2766.82	129	6588.17	51.07
	313	166	8639.52			
	322	165	8358.16			
104	330	84	4155.15	84	4155.15	49.46
138	327	149	8046.39	129	6670.33	51.71
	351	109	5294.28			
Y9731	356	150	6933.15	150	6933.15	46.22
Y9791	349	165	8703.98	165	8703.98	52.75
45	333	140	6931.33	140	6931.33	49.51
12	301	146	7204.57	165.5	8271.39	49.98
	309	185	9338.22			
22	325	162	7944.56	162	7944.56	49.04
49	324	156	7712.93	150	7327.51	48.85
	320	125	5823.34			
	342	169	8446.27			
10	332	177	9294.24	173.5	8910.64	51.36
	355	170	8527.05			
28	336	122	5621.45	143.5	7053.83	49.16
	331	165	8486.22			
7	302	187	9685.88	187	9685.88	51.80
19	326	132	7003.25	148	7824.49	52.87
	315	164	8645.73			
37	347	130	6408.03	130	6408.03	49.29
Total		**3554**		**2236.5**	**112529.55**	
Average		**148.08**		**149.1**	**50.31**	

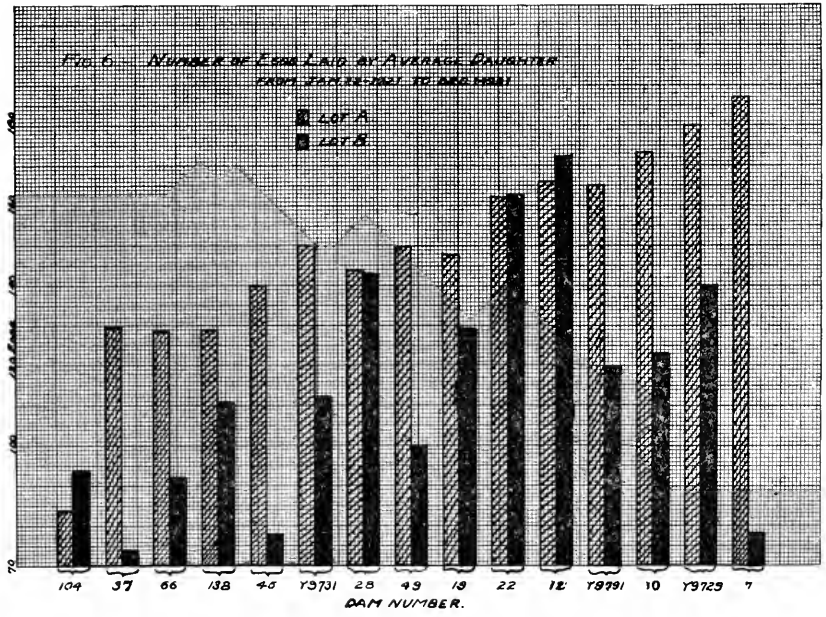


Fig. 6.—Number of Eggs Laid by Average Daughter.

TABLE XI.—Summary of Egg Production and Egg Weight to December 1, 1921. Lot B.

No. of Dam	No. of Daughter	Number Eggs Laid	Total Wt. of Eggs (Grams)	Average No. of Eggs	Average Total Wt. of Eggs (Grams)	Average Egg Weight Per Daughter
Y9729	314	140	7267.11	140	7267.11	51.91
66	338	92	4486.40	92	4486.40	48.76
104	303	94	4773.68	94	4773.68	50.78
138	341	106	5380.25	110.67	5656.78	51.12
	337	98	5075.33			
	339	128	6514.75			
Y9731	304	112	4745.10	112	4745.10	42.37
Y9791	346	74	3680.60	119	5733.97	48.18
	321	164	7787.35			
45	312	83	4358.49	77.5	3935.01	50.77
	350	72	3511.53			
12	305	180	8808.38	172	8877.57	51.61
	316	138	7107.70			
	323	183	8913.99			
	306	187	10680.22			
22	319	163	8155.41	163	8155.41	50.03
49	329	100	5340.81	100	5340.81	53.40
10	352	135	6417.38	123	6119.30	49.75
	335	111	5821.22			
28	354	143	7389.22	143	7389.22	51.67
7	348	78	4032.28	78	4032.28	51.70
19	334	126	6289.50	129	6653.78	51.58
	345	132	7018.06			
37	340	74	3627.98	74	3627.98	49.03
Total		**2913**		**1727.17**	**86794.40**	
Average		**121.37**		**115.14**	**50.25**	

Comparative Egg Production.—During the period which ended March 1, the pullets that had been well fed while young laid about four times as many eggs as did those poorly fed and in March they reached their maximum production for the season, averaging 22.94 eggs each. The maximum production of the poorly-fed daughters was reached one month later with an average of 20.49 eggs each, this production being slightly greater than that of the other lot for that particular month.

From the two maxima in March and April the production dropped with fair regularity until the end of the period covered by this report. It is to be observed that in Lot A the daughters which had been well fed led in production with the exceptions noted from month to month.

Average Egg Weight.—During the January-February period the eggs from Lot A averaged about two grams heavier than those from Lot B, but during the next few months the difference was

small, Lot A laying slightly heavier eggs. In August this condition was reversed, Lot B laying slightly heavier eggs. This result, however, was clearly due to the low average egg production of Lot B, due to extremely hot weather and to the relatively heavy production of Pullet 306 which laid 20 eggs, or more than one-eighth of the entire number for Lot B, with an average weight of more than 60 grams. In September, Lot B led slightly in egg weight, but in October and November Lot A led by about one gram per egg.

Mean Egg Production.—The mean egg production until December 1 of the "average daughters" in Lot A was 149.3 ± 4.2 and of the "average daughters" of Lot B 115.6 ± 4.8, or a difference of 33.7 ± 6.4 eggs per bird in favor of the well-fed lot. The 24 well-fed pullets laid 3554 recorded eggs, or 148.08 ± 4.4 eggs per fowl, while the 24 poorly-fed ones laid 2913 eggs, or 121.3 ± 4.8 eggs per bird, a difference of 26.8 ± 6.5 eggs in favor of the well-fed pullets. Whichever way the results are calculated the differences in production are large and striking.

It may be observed that if a poorly-balanced ration fed to little chickens should be the means of restricting the number of eggs that the pullets will lay later, then the reverse should be true that an ideal ration should increase the number of eggs. In order to obtain the maximum egg production, skillful breeding and skillful feeding and brooding of the little chickens must go hand in hand.

Mean Egg Weight.—When the average egg weight for the two lots is considered, the difference is found to be small. For Lot A, $M = 50.24 \pm .29$ and for Lot B, $M = 50.20 \pm .43$. The data do not show that the size of the egg was reduced by the insufficient ration received by the pullets of Lot B. The difference, if any, would naturally be small, at least in the first generation.

Heredity.—Tables X and XI show that, in some cases, heredity is such a powerful influence that it is able to overcome any ordinary adverse environmental factor which might affect the individual during the formative period. Pullet 306, a daughter of Hen 12, although poorly fed while young, laid as many egg (187) as any member of the flock, laid the heaviest eggs, the greatest total weight of eggs, and moreover was the heaviest bird in either Lot A or Lot B.

Of the three pullets which laid 180 or more eggs in Lot B, all were daughters of Hen 12, and of the two birds in Lot A laying 180 or more eggs, one was a daughter of Hen 12. In other words, of the five individuals laying 180 eggs or more, four were daughters of Hen 12.

SECOND YEAR'S EXPERIMENT

During the second year no change was made in the ration supplied to the fowls in Lots A and B and they continued to run together in one flock. In the summer of 1921, eggs from these fowls were incubated and the chicks handled as in the earlier experiment. The chicks receiving the two rations were designated as Lots C and D. Lot C received the well balanced ration. The first year's record for these birds begins on page 28.

Weight of Hens in Lots A and B.—Tables XII and XIII show the weight of each bird and the mean weight of the "average daughter" for each month of the year. Figure 7 shows this graphically.

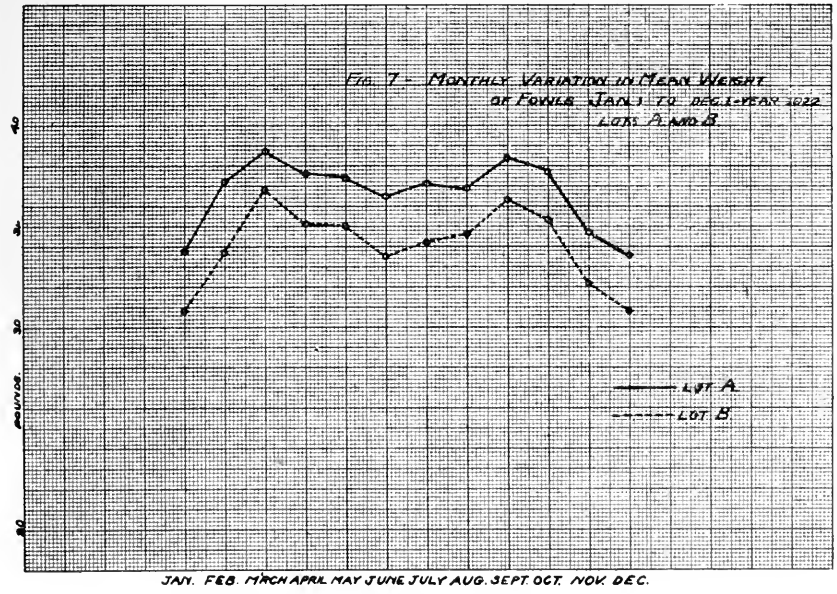


Fig. 7.—Monthly Variation in Mean Weight of Fowls, Jan. 1922 to Dec. 1922.

TABLE XII.—Weights of Hens in Lot A in Pounds

No. of Dam	No. of Daughter	January	February	March	April	May	June	July	August	September	October	November	December
Y9729	311	3.5	3.9	4.2	4.0	4.1	4.1	4.2	4.1	4.1	4.4	3.7	3.4
66	308	3.7	4.2	4.4	4.1	4.0	3.7	3.9	4.3	4.2	4.2	3.4	3.4
	313	3.5	4.2	4.2	4.1	3.9	4.0	4.1	4.0	4.2	4.0	4.5	3.4
	322	3.5	4.0	4.1	3.8	4.1	3.9	4.2	4.2	4.3	3.7	3.4	3.8
104	330	3.3	3.9	3.4	3.7	3.6	3.6	3.6	3.6	3.8	3.8	3.3	2.9
138	327	2.9	3.3	3.8	3.6	3.3	3.2	3.2	3.3	3.5	3.0	3.7	3.0
	351	4.3	4.6	4.1	3.5	3.7	3.7	3.7	3.6	4.1	4.2	4.1	3.1
Y9731	356	2.9	3.5	3.5	3.4	3.5	3.5	3.5	3.4	3.3	3.4	3.4	2.8
Y9791	349	3.3	3.4	3.4	3.4	3.7	3.8						
45	333	3.6	4.1	3.9	3.9	3.8	3.6	3.6	2.8	3.5	3.9	3.3	3.5
12	301	3.6	3.4	3.8	3.6	3.3	3.4	3.4	3.6	3.7	4.0	3.2	2.9
	309	3.2	4.1	4.0	4.1	3.8	3.9	3.9	3.8	4.0	3.3	3.0	4.1
22	325	3.2	3.4	3.8	3.5	3.5	3.4	3.8	4.1	4.1	4.0	3.0	3.1
49	324	4.2	4.3	4.4	4.2	4.0	4.0	3.8	4.2	4.2	3.9	3.5	4.1
	320	3.5	3.6	3.7	3.7	3.5	3.5	3.5	3.5	3.3	3.1	3.3	3.6
	342	4.1	4.6	4.5	4.3	4.3	4.0	4.1	3.8	4.6	4.7	3.8	3.9
10	332	3.0	3.4	3.8	3.6	3.7	3.7	3.7	3.8	4.0	3.5	3.2	3.8
	355	2.8	3.1	3.5	3.0	3.4	3.2	3.2	2.9	3.5	3.1	3.6	3.2
28	336	3.4	3.6	3.7	3.5	3.6	3.4	3.4	3.4	3.7	3.1	3.0	3.2
	331	3.4	3.7	4.1	4.0	4.1	3.7	3.8	3.9	3.5	3.4	3.5	3.5
7	302	3.4	3.7	4.2	4.2	4.0	3.9	4.0	4.1	4.1	4.4	3.9	3.4
19	326	3.6	4.0	4.3	4.2	3.8	3.8	3.9	3.8	3.6	3.1	3.5	3.8
	315	3.4	3.9	4.3	4.1	4.1	3.6	3.6	4.0	4.5	4.3	4.6	4.3
37	347	2.9	3.1	3.5	3.6	3.5	3.4	3.5	3.5	3.6	3.6	3.0	3.1
Average Daughter		**3.38**	**3.72**	**3.87**	**3.76**	**3.74**	**3.65**	**3.71**	**3.69**	**3.84**	**3.77**	**3.47**	**3.36**

TABLE XIII.—Weights of Hens in Lot B in Pounds

No. of Dam	No. of Daughter	January	February	March	April	May	June	July	August	September	October	November	December
Y9729	314	3.2	3.5	3.8	3.7	3.7	3.7	3.9	4.1	4.0	3.2	3.4	3.4
66	338	2.3	3.7	3.5	3.1	3.1	3.1	3.3	3.2	3.3	3.0	3.0	3.3
104	303	2.8	3.4	3.9	3.8	3.7	3.6	3.2	3.4	3.6	3.0	3.1	3.3
138	341	3.0	3.6	3.7	3.6	3.4	3.4	3.4	3.5	3.9	3.8	3.0	2.8
	337	2.9	3.2	3.6	3.4	3.4	3.3	3.2	3.2	3.5	3.7	2.9	2.9
	339	3.3	3.3	3.5	3.3	3.3	3.2	2.8					
Y9731	304	3.2	3.4	3.7	3.3	3.3	3.2	3.2	3.3	3.5	3.6	3.6	2.9
Y9791	346	3.6	3.8	3.9	3.6	3.5	3.4						
	321	3.4	2.7	3.4									
45	312	3.5	3.6	3.7	3.6	3.5	3.5	3.5	3.2	3.6	3.4	3.1	3.2
	350	2.8	3.1	3.2	2.9	2.8	2.6	2.7	2.6	2.7	2.3	2.3	2.6
12	305	2.8	3.0	4.0	3.6	3.6	3.3	3.5	3.8	4.0	3.0	3.3	3.5
	316	3.2	3.5	4.1	3.7	3.9	3.9	3.9	4.0	4.1	4.1	4.0	3.3
	323	2.6	2.7	3.2	3.3	3.3	3.2	3.3	2.7	3.6	3.8	3.5	3.6
	306	3.2	3.5	4.2	4.5	4.6	4.5	4.7	4.9	4.9	5.2	4.1	3.4
22	319	2.6	2.9	3.2	3.0	3.4	2.9	3.1	3.3	3.3	3.5	2.7	2.8
49	329	3.5	3.6	3.9	3.8	3.8	3.6	3.9	3.7	3.9	3.7	3.1	3.1
10	352	3.0	3.3	3.6	3.5	3.7	3.5	3.4	3.7	3.5	3.7	3.3	2.9
	335	2.9	3.4	3.4	3.2	3.1	3.2	3.4	3.3	3.2	3.3	3.4	3.4
28	354	2.7	2.6	3.4	3.3	3.2	2.9	3.3	3.2	3.5	3.7	2.8	2.6
7	348	3.6	3.8	4.0	3.8	3.6	3.5	3.5	3.5	3.9	4.1	3.2	3.2
19	334	3.5	3.4	3.9	3.5	3.7	3.3	3.3	3.3	3.5	3.6	3.2	3.1
	345	3.5	4.1	4.5	4.3	4.3	4.2	4.1	4.5	4.5	4.4	4.5	3.5
37	340	2.9	3.4	3.5	3.5	3.5	3.2	3.3	3.3	3.5	3.5	3.6	2.9
Average Daughter		**3.08**	**3.37**	**3.68**	**3.51**	**3.50**	**3.35**	**3.42**	**3.46**	**3.63**	**3.53**	**3.22**	**3.08**

During the last three months of the test the average weight of the fowls in Lot A was 3.53 ± .05 pounds and for Lot B 3.28 ± .04 pounds or an average difference of about one-fourth pound per bird. As these fowls were now in their their second year, it would appear that the unbalanced ration supplied Lot B while young had permanently affected the live weight of the individuals.

Number and Weight of Eggs Laid

Table XIV gives the mean egg production and egg weight of the "average daughter" in the two lots for each month of the second year of the test and Fig. 8 shows graphically the mean egg weights for the period under consideration.

TABLE XIV.—Mean Egg Production and Egg Weight of Lots A and B, December 1, 1921, to December 1, 1922

	LOT A		LOT B	
	Average No. Eggs Per Daughter	Average Egg Weight Per Daughter	Average No. Eggs Per Daughter	Average Egg Weight Per Daughter
December	.70	57.97	1.83	57.59
January	.83	58.69	.81	59.78
February	5.51	57.71	5.14	57.28
March	16.51	57.70	16.96	56.37
April	19.72	56.75	19.97	55.37
May	21.67	55.48	22.35	55.10
June	21.27	54.44	20.75	54.08
July	22.23	54.57	20.77	54.44
August	18.92	55.75	19.30	55.67
September	14.57	56.61	11.78	56.55
October	7.43	57.38	6.69	57.11
November	1.59	57.70	1.71	60.24

With both lots the heaviest egg production was during May, June, and July. During these months the eggs were lightest in weight and it would seem that the weight of eggs laid by mature fowls was roughly in inverse proportion to the number laid.

Tables XV and XVI give the number and weight of eggs laid by each fowl, the number and weight of eggs for each "average daughter", and the means for the two lots.

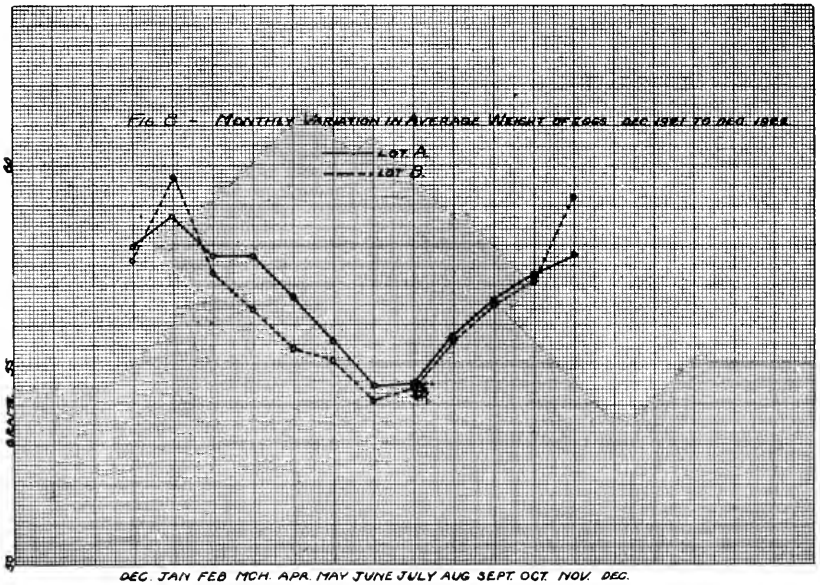


Fig. 8.—Monthly Variation in Average Weight of Eggs.

TABLE XV.—Summary of Average Egg Production Per Daughter in Lot A, December 1, 1921, to December 1, 1922

No. of Dam	No. of Daughter	No. Eggs Laid	Total Weight of Eggs in Grams	Average Number of Eggs	Ave. Total Weight of Eggs in Grams
Y9729	311	165	9851.30	165	9851.30
66	308	164	8796.54	165.67	9277.88
	313	176	9988.79		
	322	157	9048.30		
104	330	153	8560.68	153	8560.68
138	327	166	9500.03	169	9307.68
	351	172	9115.33		
Y9731	356	158	7816.74	158	7816.74
45	333	98	5368.73	98	5368.73
12	301	178	9675.83	155.50	8695.42
	309	133	7715.02		
22	325	144	8261.02	144	8261.02
49	324	135	7452.65	134	7385.05
	320	103	5400.82		
	342	164	9301.68		
10	332	140	8337.60	159.50	9431.55
	355	179	10525.51		
28	336	134	6896.96	121	6534.80
	331	108	6172.64		
7	302	192	11158.91	192	11158.91
19	326	142	7984.29	169.50	9614.95
	315	197	11245.62		
37	347	133	7243.31	133	7243.31
Total		**3491**	**195418.30**	**2117.17**	**118598.02**
Ave. Production per Daughter		**151.78**	**55.98**	**151.22**	**55.97**

TABLE XVI.—Summary of Average Egg Production Per Daughter in Lot B, December 1, 1921, to December 1, 1922

No. of Dam	No. of Daughter	No. Eggs Laid	Total Weight of Eggs in Grams	Average Number of Eggs	Ave. Total Weight of Eggs in Grams
Y9729	314	133	7905.87	133	7905.87
66	338	134	6916.34	134	6916.34
104	303	155	8629.69	155	8629.69
138	341	177	9923.02	157	8712.09
	337	137	7501.17		
Y9731	304	158	7728.34	158	7728.34
45	312	94	5409.07	113	6172.17
	350	132	6935.27		
12	305	132	7194.99	162.25	9345.27
	316	180	10117.63		
	323	181	9977.57		
	306	156	10090.88		
22	319	162	8774.26	162	8774.26
49	329	141	8583.23	141	8583.23
10	352	152	7960.14	159	8974.33
	335	166	9988.53		
28	354	156	8627.07	156	8627.07
7	348	135	7708.25	135	7708.25
19	334	146	7806.95	158.50	8958.61
	345	171	10110.28		
37	340	154	8470.64	154	8470.64
Total		**3152**	**176359.19**	**2077.75**	**115506.16**
Ave. Production per Daughter		**150.09**	**55.95**	**148.41**	**55.59**

Comparative Egg Production.—Based on the "average daughter" the egg production for Lot A was 151.22 ± 3.9 eggs, and for Lot B 148.41 ± 2.4 eggs, or a difference of 2.81 ± 4.5 which is not significant. The difference in egg weight was small, but Fig. 8 shows that during the entire year the eggs laid by Lot B were somewhat smaller than those laid by Lot A, except in January and November when egg production was too low for reliable averages.

RESULTS WITH LOTS C AND D

The fowls in Lots A and B were mated to Male 10, a son of Hen 19. Incubation was started July 3, 1921. Table XVIII shows that 389 eggs laid by 44 hens were incubated. Of these, 265 were fertile and 209 hatched. In 8 cases all the eggs laid by certain hens were fertile, and in 3 cases none. In 12 cases all the fertile eggs hatched, and in 4 instances all the eggs laid by certain hens were fertile and all hatched. These facts illustrate the wide variation in fertility and hatchability of eggs laid by females in the same flock and mated to the same male.

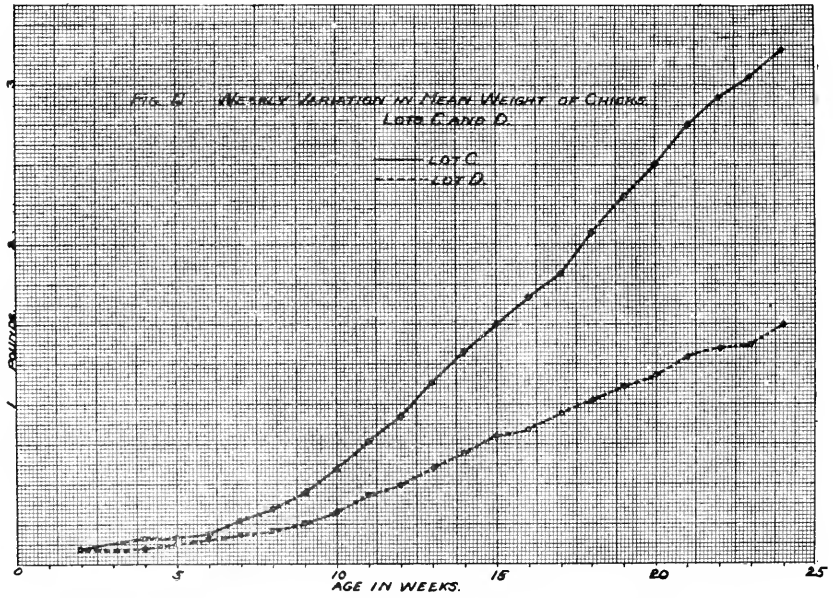


Fig. 9.—Weekly Variation in Mean Weight of Chicks, Lots C and D.

Hatching the Eggs

The following table shows a wide variation in the fertility and hatchability of the eggs laid by the different hens.

TABLE XVII.—Record of Hatch

Band No. of Dam	Number of Eggs Incubated	Number of Fertile Eggs	Number of Chicks
301	8	3	3
302	5	0	0
303	8	5	4
304	5	5	5
305	10	1	1
306	10	6	3
309	9	3	2
310	11	8	8
311	11	9	8
312	3	3	3
313	9	8	5
314	9	7	5
315	10	9	7
316	12	0	0
319	10	8	7
320	9	8	7
321	9	5	3
322	10	9	9
323	11	0	0
324	10	8	6
325	9	6	4
327	8	7	6
329	10	5	3
330	8	7	7
331	8	6	4
332	8	8	5
333	9	5	3
334	10	9	5
335	2	2	1
336	9	4	4
338	9	7	6
339	10	5	3
340	5	5	5
342	9	9	9
344	9	5	5
346	10	10	9
347	10	8	6
348	10	9	7
349	10	8	4
351	9	7	5
352	10	9	7
354	11	6	6
355	10	6	3
356	7	7	6

Feeding the Chicks

Two lots of chicks, selected as in the earlier experiment, were brooded by a Newtown colony brooder, a partition separating the

two flocks. Table XVIII shows the kind and amount of feed consumed per week per hundred chicks and Table XIX shows the weight of the chicks per hundred from week to week and the number present in each lot at the beginning of each week. Fig. 9 shows graphically the variation in the mean weight of the chicks.

TABLE XVIII.—Feed Consumed by Lots C and D

Week of Test	Feed Consumed by Lot C Per 100 Chicks				Feed Consumed by Lot D Per 100 Chicks			
	Lbs. Cracked Corn	Lbs. Mash	Qts. Whole Milk	Lbs. Meat Scrap	Lbs. Cracked Corn	Lbs. Mash	Qts. Whole Milk	Lbs. Meat Scrap
1								
2	2.4	4.2*	5.1		1.9	3.5*	.9	
3	4.6	5.6	7.8		3.8	5.0	3.0	
4	3.7	10.6	8.5		2.4	9.4	1.1	
5	2.9	11.4	9.0		2.3	7.8	1.1	.2
6	5.2	10.7	9.5		4.6	7.4	1.3	
7	3.0	17.6	10.4		2.8	13.8	1.4	
8	4.5	22.7	15.9		3.4	14.4	2.0	
9	4.7	25.0	21.2		4.4	16.3	1.4	
10	11.8	26.9	21.5		5.0	20.4	1.5	.9
11	13.4	28.4	21.5		8.2	23.0	3.2	.6
12	6.6	50.7	21.5	.8	6.0	33.9	3.2	
13	10.9	47.9	21.5	1.5	8.0	28.7	3.2	
14	14.0	40.6	21.5	2.0	10.2	21.0	3.2	
15	24.6	40.0	21.5	3.5	16.9	30.2	3.2	
16	32.3	40.8	21.5	2.4	30.6	31.4	3.2	
17	37.7	69.2**	21.5		24.2	35.5	3.2	
18	47.0	64.9**	21.5		26.6	30.2	3.2	
19	48.5	69.2**	21.5		38.4	28.7	3.2	
20	66.6	70.7**	21.5		29.0	41.1	3.2	
21	71.5	50.3**	21.5	12.3***	34.2	43.9	3.2	
22	74.6	40.7**	21.5	10.7***	35.5	43.6	3.2	
23	84.6	46.1**	21.5	10.7***	40.3	37.6	3.2	

*Corn meal 2 parts, wheat bran 1 part.
**Corn meal 2 parts, bran, middlings and meat scrap each 1 part.
***Semi-solid buttermilk.

Both lots were fed liberally on grain, yet Lot C with the greater supply of milk, consumed much more cracked corn and mash than did Lot D.

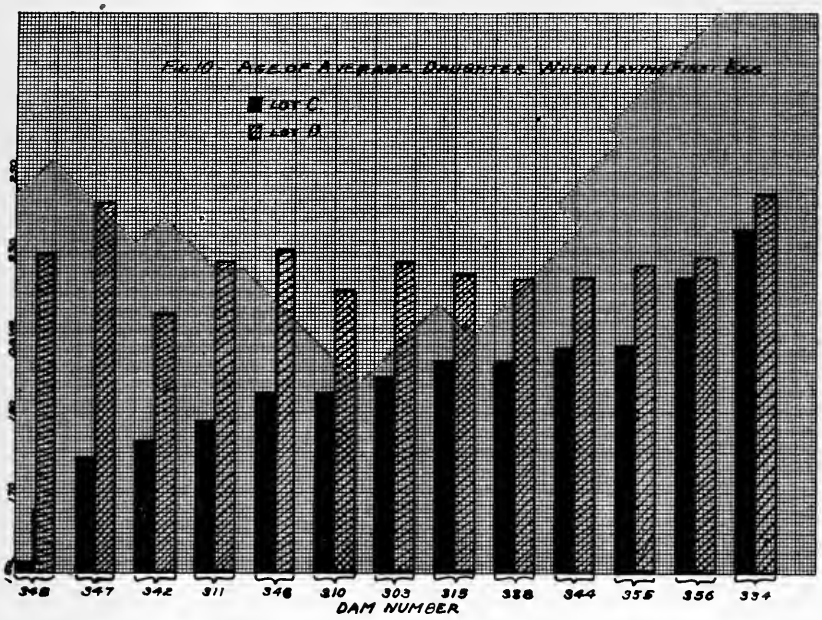


Fig. 10.—Age of Average Daughter When Laying First Egg.

TABLE XIX.—Number of Chicks in Lots C and D and Weight in Pounds Per Hundred Chicks From Week to Week

Age in Weeks	Number of Chicks		Weight of Chicks per Hundred	
	Lot C	Lot D	Lot C	Lot D
1				
2	98	108	9.1	9.3
3	90	98	—	—
4	82	87	12.32	10.92
5	78	81	17.05	13.21
6	74	77	19.19	15.32
7	67	74	27.91	18.11
8	66	73	34.39	21.92
9	66	71	45.61	26.48
10	65	68	60.15	33.82
11	65	63	76.92	43.17
12	65	62	92.61	50.32
13	65	62	113.85	60.32
14	65	62	134.47	70.32
15	65	62	150.77	80.32
16	65	62	167.54	86.45
17	65	62	182.46	95.32
18	65	62	207.70	103.22
19	65	62	230.31	111.29
20	65	62	252.00	118.55
21	65	62	276.91	130.32
22	65	62	294.61	135.48
23	65	62	307.69	137.58
24	65	62	324.31	150.41

Grain Consumption and Weight of Chicks.—Tables XVIII and XIX show that Lot C with the more liberal supply of milk not only consumed much more feed but grew much more rapidly than the others. At the close of the period the chicks in Lot C were more than twice as heavy as those in the other flock.

Weights of Pullets

Tables XX and XXI give the weight of each fowl each month and the mean weight. During the last four months the birds in Lot D averaged about one-fourth pound lighter than those in Lot C.

TABLE XX.—Weights of Fowls in Lot C in Pounds

No. of Dam	No. of Daughter	December 31	February	March	April	May	June	July	August	September	October	November	December
355	403	2.9	3.4	3.5	3.5	3.1	3.1	3.1	3.6	3.4	3.5	2.9	2.9
310	411	3.0	3.8	3.8	3.6	3.4	3.3	3.4	3.2	3.8	4.1	4.9	4.5
356	434	2.2	2.7	3.3	3.2	3.3	3.3	3.3	3.4	3.6	3.5	3.6	3.0
	428	2.7	3.7	3.7	3.7	3.2	3.4	3.4	3.6	3.8	3.4	3.3	3.7
311	401	2.8	3.3	3.4	3.0	2.9	2.7	3.1	3.4	3.4	3.3	3.0	3.2
	402	3.1	2.7	3.9	4.0	3.7	3.6	4.0	4.1	4.1	3.2	3.4	3.8
	404	3.2	3.4	4.4	4.4	4.0	3.9	3.4	4.2	4.5	4.4	3.8	4.1
348	424	3.4	3.5	3.7	3.7	3.2	2.8	3.2	3.6	3.7	4.0	4.0	4.0
303	435	2.6	3.4	3.4	3.3	3.6	3.2	3.3	3.4	3.5	3.4	3.8	3.6
344	406	2.7	3.1	3.4	2.7	3.1	3.0	2.7	3.3	3.2	3.3	3.0	3.2
	420	2.7	3.4	3.7	3.7	3.6	3.6	3.5	3.7	3.9	3.4	3.3	3.6
347	415	2.9	3.2	3.5	3.3	3.1	2.9	3.0	3.1	3.4	2.7	3.2	3.3
346	433	3.2	3.6	3.3	3.3	3.2	2.9	3.1	3.5	3.5	3.6	3.8	3.0
	407	2.9	3.8	4.0	3.7	3.5	3.3	3.5	3.8	4.1	3.8	3.4	3.9
342	409	3.0	3.2	3.1	3.1	3.1	2.8	2.6	3.0	3.3	3.5	2.9	3.2
	421	2.7	3.1	3.3	3.4	3.1	3.0	2.8	3.1	3.6	3.8	3.1	3.5
	430	2.3	2.8	2.9	2.9	2.6	3.0	2.6					
	432	3.2	4.3	4.1	3.8	3.5	3.6	3.7	4.2	4.3	4.0	4.0	5.0
315	431	2.3	2.8	3.3	3.1	3.0	3.0	3.0	3.2	3.2	3.4	3.1	3.5
334	422	2.2	2.5	3.2	3.1	3.0	3.1	2.7	3.2	3.1	2.8	3.1	3.2
338	412	2.4	3.2	3.5	3.8	3.3	3.2						
	419	2.8	3.3	3.7	3.5	3.4	3.0	2.9	3.4	3.7	3.4	3.6	3.7
Average		**2.76**	**3.27**	**3.50**	**3.43**	**3.26**	**3.13**	**3.14**	**3.44**	**3.58**	**3.48**	**3.50**	**3.58**

TABLE XXI.—Weights of Fowls in Lot D in Pounds

No. of Dam	No. of Daughter	December 31	February	March	April	May	June	July	August	September	October	November	December
355	440	1.1	1.9	2.7	2.6	2.2	2.8	2.5	2.6	2.8	3.1	2.4	2.6
310	426	1.5	2.6	3.1	3.0	2.8	2.9	2.8	3.0	3.1	2.9	2.9	3.6
356	439	1.7	2.5	3.6	3.4	3.3	2.9	3.0	3.3	3.6	3.5	3.7	3.6
	441	.8	1.7	2.0	2.7	2.2	2.4	2.4	2.6	2.7	2.7	3.0	2.3
311	427	1.2	2.3	3.1	3.2	3.0	2.5	3.3	3.4	3.7	3.8	3.9	3.3
	414	1.7	2.5	3.2	3.3	3.2	3.1	2.2	3.0	3.5	3.7	3.7	3.6
348	418	1.3	2.2	3.1	3.3	3.1	2.9	2.9	3.0	3.4	3.5	2.8	2.8
303	405	1.1	2.1	2.8	3.1	2.9	2.8	3.2	3.3	2.9	3.0	3.7	4.1
344	413	1.6	2.4	3.2	2.9	2.8	2.9	2.8	3.0	3.3	2.9	2.9	3.2
347	437	1.1	2.0	2.7	3.0	2.6	2.3	3.4	3.2	3.4	3.6	3.7	2.9
	443	.7	1.0	1.4	2.2	1.8	2.2	2.2	2.1	2.3	2.9	3.0	2.5
346	410	2.1	3.1	3.6	3.7	3.4	3.0	3.6	3.6	3.9	3.9	3.2	3.5
	417	1.2	2.1	2.7	3.1	2.9	2.9	3.2	3.4				
342	442	1.3	2.3	2.9	3.2	3.0	2.8	3.0	3.0	3.2	3.4	3.0	3.1
	408	2.0	2.9	3.1	2.9	2.5	2.6	2.9	3.3	3.5	3.0	3.2	3.6
	425	1.7	2.7	3.3	3.4	3.3	3.0	3.2	3.5	3.8	3.9	4.1	3.2
315	423	1.8	2.5	3.3	3.3	3.2	3.2	2.9	2.7	3.2	3.5	3.6	3.2
	436	1.2	2.1	2.7	3.1	2.4	2.9	2.7	2.7	3.2	3.3	3.2	3.4
334	416	1.0	1.9	2.3	2.8	3.1	3.3	3.3	3.5	3.9	4.3	3.3	3.3
338	438	2.2	3.0	3.1	3.2	3.1	2.6	2.9	3.3	3.5	3.8	3.1	3.7
	429	1.8	2.6	3.1	3.3	3.0	3.1	2.9	3.1	2.9	2.9	3.3	3.4
Average Daughter		**1.39**	**2.26**	**2.89**	**3.05**	**2.84**	**2.84**	**2.91**	**3.07**	**3.30**	**3.37**	**3.21**	**3.26**

Age When First Egg Was Laid

The first egg obtained was laid by Pullet 424 on December 25, and the two lots of fowls were placed together on December 31. Owing to lack of room these pullets were placed in the laying house with their dams A and B. This made the house somewhat overcrowded. On May 1, Lots C and D were transferred to another house, thus providing better accommodations. They were fed the same ration as their dams.

Table XXII gives the age of each pullet when she laid the first egg. The mean age for the "average daughter" of Lot C was 197.8 $\pm$ 3.7 days and for Lot D was 228.5 $\pm$ 1.7 days, or a difference of 30.7 $\pm$ 4.1 days. It may be observed here that one probable reason why these birds were considerably older than their dams when they began to lay was because they were placed in the same laying house with their dams and did not have the best possible opportunity to develop. Figure 10 shows the effect of the rations as influencing the age of arriving at sexual maturity.

TABLE XXII.—Age at Which First Egg Was Laid by Lots C and D

No. of Dam	Lot C		Lot D	
	No. of Daughter	Age in Days First Egg Was Laid	No. of Daughter	Age in Days First Egg Was Laid
353	403	207	440	227
310	411	195	426	221
356	434	249	439	219
	428	199	441	240
311	401	177	427	227
	402	180	414	230
	404	207		
348	424	153	418	230
303	435	199	405	228
344	406	225	413	224
	420	188		
347	415	179	437	228
			443	257
346	433	192	410	226
	407	198	417	237
342	409	164	442	229
	421	180	408	194
	430	188	425	223
	432	201		
315	431	203	423	218
			436	232
334	422	236	416	245
338	412	199	438	205
	419	207	429	242

Number and Weight of Eggs Laid

Table XXIII gives the egg production and egg weight of the "average daughter" in the two lots for each month. Tables XXIV and XXV give the total number of eggs produced and the total egg weight for each pullet; the number and egg weight for the "average daughters"; and the mean number of eggs and egg weight per "average daughter." Figure 11 shows graphically the variation in egg weight of the two lots and Figure 12 shows the mean monthly egg production.

TABLE XXIII.—Mean Egg Production and Egg Weight of Lots C and D, January, 1922, to December, 1922

	Lot C		Lot D	
	Average No. Eggs Per Daughter	Average Egg Weight in Grams per Daughter	Average No. Eggs per Daughter	Average Egg Weight in Grams per Daughter
January	2.69	42.88	.00	.00
February	5.63	46.00	.68	44.73
March	16.02	48.55	12.28	47.30
April	19.01	49.64	17.05	48.39
May	13.89	48.61	12.73	48.48
June	19.65	51.30	16.15	49.54
July	19.95	52.16	11.74	51.13
August	19.91	53.61	16.79	52.02
September	13.65	54.53	14.25	53.01
October	5.77	57.14	8.10	53.44
November	4.01	60.80	3.86	54.87

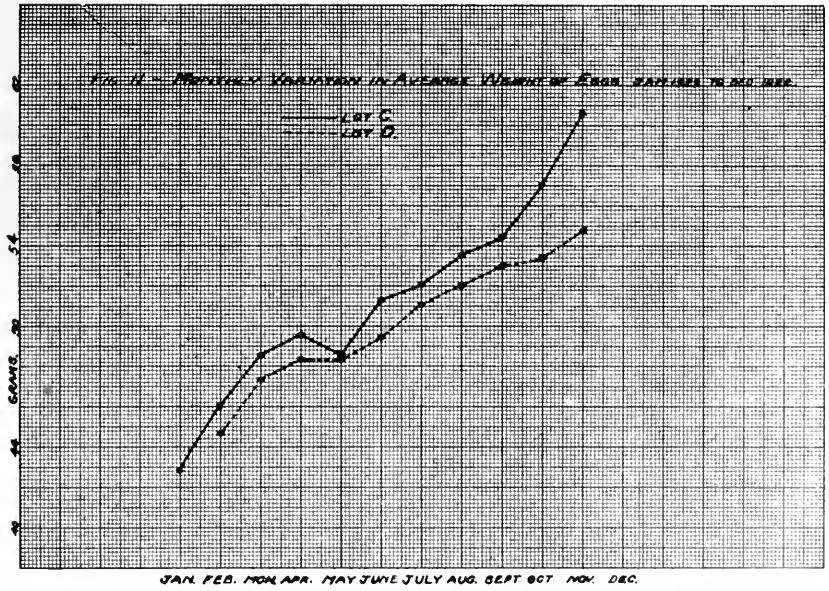


Fig. 11.—Monthly Variation in Average Weight of Eggs, Lots C and D.

The table shows that the maximum egg production of Lot C was in July, while the heaviest production of Lot D took place earlier in the summer. With both lots the average weight of the eggs increased with fair regularity from month to month.

TABLE XXIV.—Summary of Average Egg Production Per Daughter in Lot C, December 1, 1921-1922

No. of Dam	No. of Daughter	No. Eggs Laid	Total Weight in Grams	Average No. Eggs	Ave. Total Wt. in Grams
355	403	123	6519.84	123	6519.84
310	411	108	5653.91	108	5653.91
356	434	147	7392.28	135.50	6955.35
	428	124	6518.43		
311	401	148	7153.63	136.33	6915.46
	402	150	7912.45		
	404	111	5680.29		
348	424	203	10516.79	203	10516.79
303	435	208	11014.84	208	11014.84
344	406	108	5353.91	130	6700.88
	420	152	8047.86		
347	415	134	6126.77	134	6126.77
346	433	180	9789.58	152.50	8053.48
	407	125	6317.39		
342	409	156	8214.46	150.67	7709.77
	421	150	7215.44		
	432	146	7699.42		
315	431	133	6864.68	133	6864.68
334	422	82	4281.90	82	4281.90
338	419	144	7204.47	144	7204.47
Total		**2832**	**145478.34**	**1840.00**	**94518.14**
Average Production per Daughter		**141.60**	**51.37**	**141.54**	**51.37**

TABLE XXV.—Summary of Average Egg Production Per Daughter in Lot D, December 1, 1921-1922

No. of Dam	No. of Daughter	No. Eggs Laid	Total Weight in Grams	Average No. Eggs	Ave. Total Wt. in Grams
355	440	112	5690.74	112	5690.74
310	426	111	5358.97	111	5358.97
356	439	186	9434.49	153	7534.27
	441	120	5634.05		
311	427	168	8187.91	112.50	5427.31
	414	57	2666.71		
348	418	143	6981.77	143	6981.77
303	405	97	4920.26	97	4920.26
344	413	107	5299.52	107	5299.52
347	437	126	6409.39	93	4628.68
	443	60	2847.98		
346	410	136	8005.22	136	8005.22
342	442	120	6353.26	137.33	6843.33
	408	135	6300.72		
	425	157	7876.00		
315	423	125	6223.91	141.50	7136.25
	436	158	8048.60		
334	416	118	5964.36	118	5964.36
338	438	140	7108.11	109.50	5612.33
	429	79	4116.56		
Total		**2455**	**123428.53**	**1570.83**	**79403.01**
Average Production per Daughter		**122.75**	**50.28**	**120.83**	**50.55**

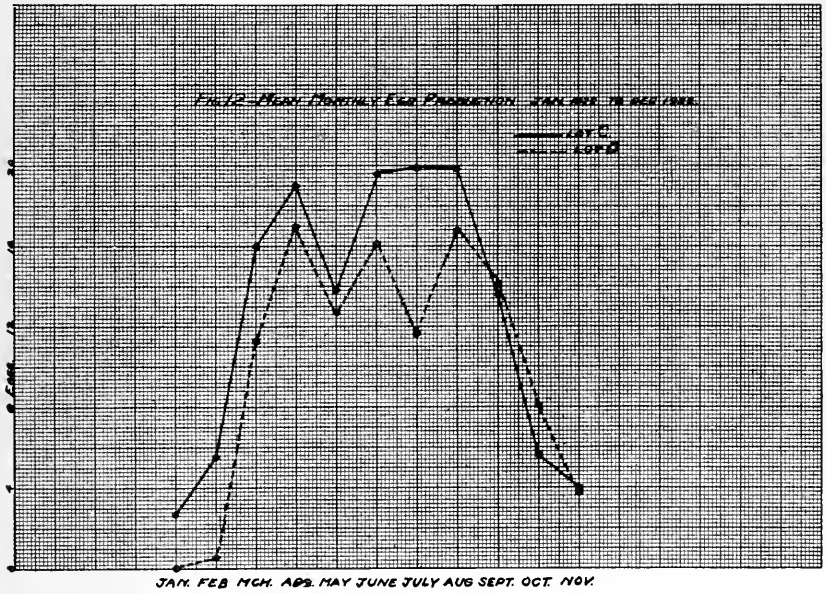


Fig. 12.—Mean Monthly Egg Production, Jan. 1922 to Dec. 1922.

In Lot C the number of eggs laid varied from 82 to 208, and in Lot D from 57 to 186. The "average daughter" in Lot C laid 141.54 ± 6.1 eggs, while their full sisters in Lot D laid 120.83 ± 3.4, a difference of 20.71 ± 6.9 eggs per bird in favor of the well-fed lot. For Lot C the egg weight averaged 51.37 ± .31 grams and for Lot D 50.55 ± .38 grams, the difference of .82 ± .49 grams probably not being significant. These results are in general agreement with those obtained with lots A and B for the first year.

Effect Upon the Progeny of the Improper Nourishment of the Dam

In Lots C and D there were four classes of pullets: well-fed pullets from well-fed dams; well-fed pullets from poorly-fed dams; poorly-fed pullets from well-fed dams; and poorly-fed pullets from poorly-fed dams.

Although the data are too meagre to justify definite conclusions, yet it is interesting to observe the age of laying the first egg for these four classes of pullets. The following schedule shows the results.

No. of Daughters	Treatment of Daughters	Treatment of Dams	Age First Egg Was Laid	Difference in Days
12	Well fed	Well fed	194.5 ± 4.0	
10	Well fed	Poorly fed	199.2 ± 4.4	4.7 ± 5.9
11	Poorly fed	Well fed	224.3 ± 2.2	
9	Poorly fed	Poorly fed	228.7 ± 2.4	4.4 ± 3.3

The difference in the age of the daughters when laying the first egg, due to the rations supplied their dams, was not great enough to be significant; and it seems probable that the number of individuals in each class was too small to show any definite change.

Correlation Between Age of Hen When Laying the First Egg and Her Subsequent Egg Production

Is there any relation between precociousness in fowls and total egg production during the first year? If so, this would suggest a method for selecting the best layers.

It is evident that a pullet that begins to lay early in the fall has an advantage in respect to time over one that begins to lay later in the season, but it does not necessarily follow that the first to lay will lay the greater number of eggs during the pullet year.

The method used in calculating the correlation was that described by Dr. Frank M. Phillips in Monthly Weather Review, Vol. 50, No. 3. The age in days when laying the first egg and the number of eggs laid during the pullet year, or prior to December 1, constituted the balanced members. The results are shown below:

Lot A—First year ..... $r = -.24 \pm .13$
Lot B—First year ..... $r = -.53 \pm .10$
Lot C—First year ..... $r = -.53 \pm .11$
Lot D—First year ..... $r = -.41 \pm .12$

All of the coefficients are negative, which is another way of saying that the birds that began to lay first, in general, laid more eggs during the pullet year than those that began to lay later.

SUMMARY OF RESULTS

The results of this series of experiments seem to justify the following conclusions:

1.—A poorly-balanced ration fed to young chickens not only reduced the rate of gain in live weight but also reduced the mature weight of the females.

2.—A poorly-balanced ration fed to young chicks increased the age of the pullets before reaching sexual maturity or, in other words, before laying the first egg.

3.—A poorly-balanced ration fed to young chicks materially reduced the number of eggs laid by the pullets during the first laying season, and to a slight extent the number of eggs laid during the second year.

4.—A poorly-balanced ration fed to young chicks had little, if any, effect upon the average weight of eggs. More data should be obtained.